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ABSTRACT

Reported are the technical aspects of a year-long Olympus study of marine education. Of this four-section report, Part A describes research project procedures, time lines, and methodology followed in the conduct of the project. Section B presents the more than 225 marine occupations which were identified in a survey of 22,000 personnel. The reduction of these listings into a one-page cluster chart is shown. Section C contains discussions of career opportunities for marine technicians and careers in diving; neither of these units is in the final report. The last section is a proposed boatbuilding curriculum; the curriculum is not included in the final report. (Author/CP)

TECHNICAL REPORT

Prepared for the U.S. Office of Education
pursuant to Contract Number OEC-0-74-9247

June 1975

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Boston, Ma. 02116

This document reports on the technical aspects of the year long Olympus study of marine education leading to the report: Marine Education: Guidelines for Curriculum Development. It should be read as a companion document to the three quarterly reports issued during the course of the project.

Section A, the project research procedures and time lines, describes the methodology followed in the conduct of the project.

In preparing the Final Report it was necessary to reduce considerable detailed information and organize it for easy retrieval and analysis.

Section B illustrates an example of this data reduction. In revising the Marine Occupational Cluster it was necessary to move form concept to application. To do so, specific occupational titles and employing industries were identified, assessed and grouped. Marine employment settings were sifted out of more than 59 four digit code groups in the Standard Industrial Classification Manual. Similarly, over 200 occupational titles were located and reported on. This data provides part of the basis for the one-page cluster chart that was a key part of the Final Report. This typifies the data reduction process the project staff followed in order to keep the Final Report as concise and readable as possible.

Section C includes two discussions prepared as special units. In response to the interest of educators in the term "marine technician" the project staff researched and produced a statement on this descriptor. Similarly, the enthusiasm perceived for "diving" as a possible career influenced the project staff to develop a paper on "Careers in Diving".

Neither of these units belonged in the final product but nevertheless represent a valuable resource mode available to the USOE program officers who monitored this investigation.

Section D of this report is a proposed boatbuilding curriculum. This section was included in an early draft of the Final Report but was considered beyond the scope of the project and consequently was deleted. Also suggestions are made concerning professional development, implementation, and test site evaluation.

PROJECT RESEARCH AND PROCEDURES

A special strategy was called for to achieve eight objectives in the twelve month study and production time frame. This strategy included at least three major efforts carried out almost simultaneously.

1. A manpower effort that was comprehensive enough to cover the field and, at the same time, sufficiently detailed to describe specific occupations in demand or projected;

2. A search of programs, curricula and curriculum materials that are sensitive and relevant to the needs of young persons in the early grades K-8; and

3. A systematic study of occupational content to produce curriculum guidelines for use in programs of vocational skill development in the high school and post-secondary technical/ community college grade levels.

Directions and suggestions from Office of Education Specialists, other cluster project directors, and the advisory committee and technical experts were incorporated into the original procedures and time lines set down in the technical proposal and subsequent revision (May 31 communication to Ms. M. Washington).

Almost immediately the determination was made and consensus was reached that the term "marine science" was inappropriate to describe a major occupational cluster. The most cursory examination of the marine manpower picture made it quite clear that "marine science", while currently a popular term, represents only a fraction of the total marine field.

From this beginning a new revised cluster began to emerge charting five major sub-fields and various employment settings. This initial revision became the framework for the data collection and analysis that was fundamental in the performance of Objectives 1, 2 and 3.

OBJECTIVE 1

It was anticipated that in order to determine the manpower needs (Objective 1), a situation report would be developed that would encompass a manpower analysis and an occupational needs study or, described in terms of tasks, a measurement of current employment and a forecast of future employment. A set of activities were proposed to accomplish each of these tasks.

The Occupational Analysis first "charted" the overall field of Marine Science in order to identify more precisely the distinguishable sub-fields and then focused more intensively on the sub-fields identified.

Manpower Analysis

To perform the manpower analysis, four activities were identified. The first involved charting the field (as part of the cluster revision specified in Objective 7), analyzing the major branches and constructing a matrix to identify occupations by SIC code.

Next, all available data concerning the present and future supply and demand for marine occupations were gathered. The supply and demand factors which form the parameters of the marine manpower labor market by occupation, industry and region were isolated and analyzed. A description of the types of employers and sources of labor supply were identified.

The third activity was the examination of the specific characteristics and structure of each marine specialty. However, it was not possible to isolate specific occupations and wage structures.

A fourth activity in the manpower analysis phase of Objective 1 was an attempt at cross-classification of the commonalities of each generic marine occupational family by function, major skill requirements and similarities of working conditions.

The commonality search was begun with the assistance of employers and educators. A set of skills were identified, rank ordered and then displayed in a matrix opposite the employment settings that had been identified in the revised cluster. What emerged was a very simple and elementary matrix that displayed the level of competency an employer might expect of an

employee in over fifty broad skill areas. The usefulness of such a matrix for the development of curriculum can be readily seen. However, an adequate commonality search and cross-classification by skills and occupations will require approximately three man-years of subsequent. This proposed commonalities' search to meet the needs of both students and employers must be based on task statements of all relevant occupations. Few task statements or task analyses were available to the study team.

Occupational Needs Study

The occupational needs study was seen to involve a number of activities which culminated in the preparation of the Manpower Situation Report. The first step toward accomplishing this part of Objective 1 was the identification of business firms and public agencies most likely to employ marine personnel. A sampling of these firms and agencies was made and contact with specific industry representatives followed.

Representatives of corresponding training institutions were identified and contacted to determine the level of supply. Other labor supply sources were identified and comparative supply/demand data was compiled.

With the advice and assistance of industry representatives, the Bureau of Labor Statistics and Departments of Commerce, Transportation and Interior, projections to 1980 of supply and demand by industry, type of employer and occupation were then made.

The Marine Manpower Situation report details specific methodologies followed in determining and analyzing the tremendous amounts of data that were collected, extrapolated, and analyzed.

OBJECTIVE 2

While the emphasis of this study was chiefly concerned with vocational skill development to be faithful and consistent to the principles and potential of career education, the study team viewed program offerings in a broad perspective. Objectives 1 and 2, Determine the Extent of Curricula Currently Offered in K-14, raised questions that required answers expressed in quantitative terms. But this broad perspective made the problem of program identification difficult simply because of the potential overlap between Marine Cluster and closely related clusters such as water quality fields in both the Environment and the Agri-Business and Natural Resources Cluster. An early task, therefore,

was the development of a methodology for placing boundaries on the Marine Cluster. This methodology is discussed in the introduction of this report.

The following procedures were used to accomplish the second objective: (Many of the steps and procedures have also been reflected in the manpower study and the revision of the Marine Cluster.)

A set of criteria was formulated and specific guidelines developed that permitted the identification of programs, courses of study and occupational areas that are part of the Marine Cluster.

Next, the criteria were refined based on OE Code titles, DOT number, census code and similar methods for classifying occupational and educational information.

Following that, a search of curricula offerings and the identification of selected bibliographic references began. Selected state supervisory personnel in all regions of the United States were contacted to assist in the identification of marine curricula. Education directors of museums, aquariums and education related institutions located on East and West Coasts, Gulf, Great Lakes, and the interior of the United States were also contacted for assistance in identifying programs. Interviews of school-based persons were conducted and a record of their knowledge of the extent of existing marine curricula was made.

A matrix to display our best estimate of program enrollments in each of the major sub-fields of the Marine Cluster was then constructed. These estimates of enrollment were based on statistical extrapolation of the data collected.

The report on the extent of curricula offerings according to program areas, educational level and course content was the end result of this objective.

OBJECTIVE 3

There were two major parts to Objective 3: a) determining what is in place and, b) what is under development. Where Objective 2 was chiefly concerned with determining the extent of offerings, Objective 3 calls for assessing in qualitative terms, the make-up or content of program offerings.

To accomplish this objective, the determination of the extent of existing curricula and curriculum materials, two approaches were followed. Standard procedures were used to identify and assess those parts of the curricula, instructional program and curriculum materials that are common to all quality organized educational experience. In addition, a special methodology had to be developed to identify and evaluate those elements that are unique to each specialized area of education.

Using the criteria developed in performance of Objective 2 and with the assistance of the advisory committee and technical experts, sites were selected across the country in every region and personal visits were made to examine curricula and materials in place. In addition to actual on-site observation and discussion, curricula and curriculum materials were identified and collected from hundreds of programs at every educational level. Materials were sorted and classified by type, content, level and emphasis. Assessment was largely based on ease of access, ability to replicate or modify, age, and career education emphasis.

OBJECTIVES 4 and 5

The determination of program offerings needed (Objective 4) and of curricula and curriculum materials needed (Objective 5) was based on the data collected and assessed in performance of the previous objectives.

Three major determinants were considered in measuring the need for programs, curricula and materials: 1) Manpower needs, 2) Extent of available programs, curricula and curriculum materials and, 3) Student needs.

Manpower needs provided an index of the demand for program graduates and the need to adjust program enrollments accordingly. Measurement of current program offerings and available curricula and materials allowed the project staff to reconcile manpower opportunities against student needs. Student needs must be considered by Congressional mandate and can be measured by enrollment levels and other interest indicators, such as extra-curricular activities.

In the course of performing these objectives, comparisons were made by region and state of employment levels in each of the sub-fields of the Marine Cluster against enrollments, placement and employer satisfaction. Areas of over subscription and/or under supply were identified.

Curricula and materials developed for other OE clusters were examined as a means of identifying deficiencies in existing curricula and materials. Recommendations were solicited from students, instructors, guidance personnel and administrators.

OBJECTIVE 6

In order to identify the physical, social, moral and ethical values and considerations related to marine occupations, an extensive literature search was

conducted and a topic list was developed of the major problems, dilemmas and similar issues of relevance.

During the course of the project, suggestions, advice, and direction was sought in adding, subtracting and combining topics. Topics ranked according to current and future importance and major concepts were developed. Recommendations from the advisory committee and special interest groups were considered.

While the list was being developed, existing curricula and curriculum material was assessed to determine the adequacy of its treatment of these key issues.

OBJECTIVE 7

As previously discussed, the revision of the marine cluster began almost immediately and was influenced primarily by results of the manpower study. However, current studies on clustering techniques were closely examined and parameters were set with the advice and assistance of other cluster project directors, advisory committee members and technical experts.

A number of different formats for display were

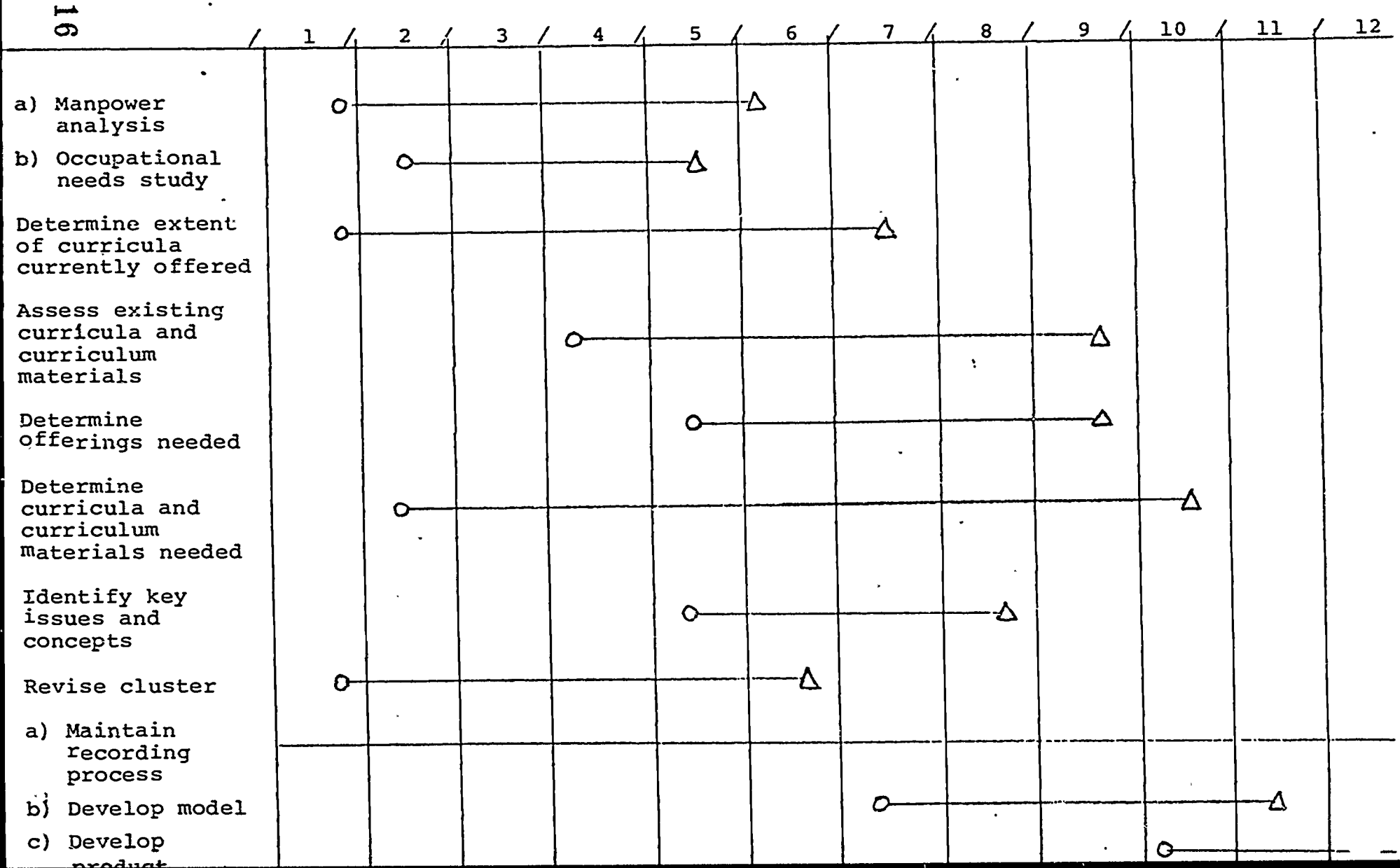
attempted and field tested in workshops and classrooms to determine clarity and usefulness.

OBJECTIVE 8

The total disarray of marine education activities made it impossible to design a model based on current best practices. Fortunately, a highly successful and field tested K-14 model had been developed for the Public Service Occupations Cluster. The relevance and potential utility of the P.S.O. project had been cited by U.S.O.E. personnel who had participated in its development. The study team was fortunate in gaining the consulting services of the P.S.O. project director who has made many valuable suggestions and recommendations.

MAJOR PROJECT TASK

TIME LINES



MARINE OCCUPATIONS

The more than 225 marine occupations identified on the following pages by occupational family represent the combined listings of Marine Occupations in the Texas Coastal Zone and the marine cluster section of An Analysis of Fifteen Occupational Clusters Identified by the U.S. Office of Education. These sources give six-digit DOT occupational code listings for marine industries from the 22,000 jobs reported at this level in 9 categories. In addition to providing a logical framework for program development, the DOT is the accepted classification system and is used by most educators and all state employment agencies to fill job orders. In the listing provided, some descriptions have been modified where appropriate and some have evolved according to local applicability. More modification and development of new codes is needed to cover in detail the full range of the new marine cluster.

SCIENTIFIC

APPLIED STATISTICIAN (See D.O.T.--020.188)

BIOLOGICAL OCEANOGRAPHER (See D.O.T.--024.081)

BIOLOGICAL STATISTICIAN
(See Statistician, Applied in D.O.T.--020.188)

CHEMICAL OCEANOGRAPHER (See D.O.T.--024.081)

FISHERY BACTERIOLOGIST (See D.O.T.--041.081)

FISHERY SCIENTIST (See D.O.T.--)

GEOLOGICAL OCEANOGRAPHER (See D.O.T.--024.081)

GEOPHYSICIST (See D.O.T.--024.081)

HYDROGRAPHER (See D.O.T.--025.288)

HYDROLOGIST (See D.O.T.--024.081)

PALEONTOLOGIST (See D.O.T.--024.081)

PETROLEUM GEOLOGIST (See D.O.T.--024.081)

PETROLOGIST (See D.O.T.--024.081)

PHYSICAL OCEANOGRAPHER (See D.O.T.--024.081)

MARINE (AQUATIC) BIOLOGIST
(See D.O.T.--041.081)

SEISMOGRAPH SHOOTER (See D.O.T.--931.381)

ENGINEERING

ACOUSTICAL (ELECTRONIC) LOGGING ENGINEER
(See D.O.T.--010.288)

CIVIL ENGINEER (See D.O.T.--005.081)

COASTAL AND OCEAN ENGINEER (See D.O.T.--)

DRAFTSMAN, HULL (See D.O.T.--014.)

DRAFTSMAN, HULL-BALLAST CALCULATION
(See D.O.T.--019.188)

DRAFTSMAN, HULL-STRESS CALCULATION
(See D.O.T.--017.281)

DRAFTSMAN, HYDRAULIC (See D.O.T.--014.

DRAFTSMAN, SHEET METAL (See D.O.T.--014

DRAFTSMAN, SHIP ENGINEERING
(See D.O.T.--014.)

MARINE ARCHITECT (See D.O.T.--001.081)

MARINE DRAFTSMAN (See D.O.T.--014.281)

MARINE ENGINEER (See D.O.T.--014.081,
014.187)

MUD ENGINEER (See D.O.T.--010.081)

OCEANOGRAPHIC ENGINEER (See D.O.T.--024

PETROLEUM ENGINEER (See D.O.T.--010.081

SUPERVISING CIVIL ENGINEER
(See D.O.T.--005.081)

TECHNICAL

ACIDIZER (See D.O.T--930.782)

CIVIL ENGINEERING TECHNICIAN
(See D.O.T.--005.)

CIVIL ENGINEERING TECHNICIAN (DRAFTSMA
(See D.O.T.--005.281)

DIVER (See D.O.T.--899.281)

DIVER HELPER (See D.O.T.--899.884)

DIVER PUMPER (See D.O.T.--899.782)

LABORATORY ASSISTANT OR SANITARIAN
(See D.O.T.--381.887)

LABORATORY TESTER (See D.O.T.--029.181

MARINE TECHNICIAN (See D.O.T.--

MICROBIOLOGY TECHNOLOGIST
(See D.O.T.--078.281)

MUD-LOGGING ANALYSIS OPERATOR
(See D.O.T.--010.281)

QUALITY CONTROL TECHNICIAN
(See D.O.T.--)

SKIN DIVER (See D.O.T.--379.884)

SURVEYING AIDE (See D.O.T.--018.)

SURVEYING TECHNICIAN (See D.O.T.--018.188)

TECHNICIAN (See D.O.T.--637.684)

MANAGERIAL

CONSTRUCTION INSPECTOR (See D.O.T.--182.287)

DECK CAPTAIN (See D.O.T.--197.)

DOCKMASTER (See D.O.T.--891.138)

DRYDOCK HEAD LINEMAN (See D.O.T.--891.884)

DRYDOCK HEAD LINE-UP MAN
(See D.O.T.--891.884)

DRYDOCK MAINTENANCE ENGINEER
(See D.O.T.--891.183)

FOREMAN (CONSTRUCTION AND MAINTENANCE)
(See D.O.T.--869.138)

HEAD WELL PULLER (See D.O.T.939.131)

LABORATORY CHIEF (See D.O.T.--976.131)

LEASE OPERATOR (See D.O.T.--939.782)

MANAGER, MARINE SERVICE (See D.O.T.--187.168)

MUD-LOGGING ANALYSIS SUPERINTENDENT
See D.O.T.--010.168)

SUPERINTENDENT
(See D.O.T.--197.)

TOOL PUSHER (See D.O.T.--930.130)

FITTERS

ACETYLENE-PLANT OPERATOR
(See D.O.T.--549.885)

BOILERMAKER (See D.O.T.--804.281)

BOILERMAKER-RIGGER (See D.O.T.--

BUCKER (See D.O.T.--800.887)

BURNER (See D.O.T.--)

CAULKER (See D.O.T.--843.)

CEMENTMAN (See D.O.T.--)

CHIPPER (See D.O.T.--800.)

COLD PRESSMAN (See D.O.T.--617.280)

COPPERSMITH (See D.O.T.--862.281)

DRILLER (See D.O.T.--809.884)

GRINDER (See D.O.T.--705.884)

LAYER-OUT (See D.O.T.--809.291)

LOFTSMAN (See D.O.T.--661.381, 661.131)

MACHINIST, OUTSIDE (See D.O.T.--623.281

MARINE ENGINE MACHINIST
(See D.O.T.--623.281)

PIPE COVERER OR INSULATOR
(See D.O.T.--863.381)

PIPE FITTER (See D.O.T.--862.281)

PUNCH-PRESS OPERATOR (See D.O.T.--615.7

RATPROOFER (See D.O.T.--)

REAMER (See D.O.T.--)

RIVET HEATER (See D.O.T.--504.885)

RIVETER (See D.O.T.--800.782)

ROLL OPERATOR (See D.O.T.--709.)

SHEAR OPERATOR (See D.O.T.--615.782, 615,885)

SHEET METAL WORKER (See D.O.T.--804.281)

SHIPFITTER (See D.O.T.--806.381)

STRAIGHTENER (See D.O.T.--709.884, 617.782)

TANK TESTER (See D.O.T.--)

TEMPLATEMAN (See D.O.T.--)

TOOL AND DIE MAKER (See D.O.T.--601.280, 601.281)

WELDER (See D.O.T.--810.884)

COMMUNICATIONS

METEOROLOGIST (See D.O.T.--025.088)

RADIO OPERATOR (See D.O.T.--193.282)

TECHNICAL WRITER (See D.O.T.--139.288)

SUPPORTIVE

ADMIRALTY LAWYER (See D.O.T.--110.118)

MARINE (INDUSTRIAL) ECONOMIST (See D.O.T.--050.088)

MARKET-RESEARCH ANALYST (See D.O.T.--050.088)

PURSER (See D.O.T.--197.168)

ELECTRICAL

DIESEL ELECTRICIAN (See D.O.T.--825.281)

ELECTRICIAN (See D.O.T.--825.138, 825.281)

MAINTENANCE ELECTRICIAN (See D.O.T.--824.281)

CRAFTSMEN

DOCKMAN (See D.O.T.--891.884)

MILL AND MAINTENANCE CARPENTER (See D.O.T.--860.281)

PAINTER (See D.O.T.--840.781)

ROUGH PAINTER (See D.O.T.--741.884, 741.887)

SHIP CARPENTER (See D.O.T.--860.381)

SHOTBLASTER (See D.O.T.--503.887)

WOOD CAULKER (See D.O.T.--843.884)

MECHANICS

AIR COMPRESSOR AND BOILER OPERATOR (See D.O.T.--950.885, 950.782)

AUTOMOTIVE MECHANIC (See D.O.T.--620.28

CRUDE-OIL TREATER (See D.O.T.--541.782)

DERRICKMAN (See D.O.T.--930.782)

DRYDOCK PUMPMAN (See D.O.T.--891.884)

ENGINEMAN (See D.O.T.--950.782)

GAUGER (See D.O.T.--914.381)

MOTORBOAT MECHANIC (See D.O.T.--623.281

MOTORBOAT-MECHANIC HELPER (See D.O.T.--623.884)

OIL WELL CEMENTER (See D.O.T--930.281)

OIL WELL PERFORATOR OPERATOR (See D.O.T.--931.782)

ROTARY DRILLER, MARINE OPERATIONS (See D.O.T.--930.782)

SEAMEN

ABLE (BODIED) SEAMAN (See D.O.T.--911.8

BOATSWAIN (See D.O.T.--911.131)

CADET (DECK DEPARTMENT) (See D.O.T.--91

CADET (ENGINEERING DEPARTMENT)
(See D.O.T.--197.130)

CAPTAIN OR MASTER (See D.O.T.--197.168)

CHIEF COOK (See D.O.T.--315.131)

CHIEF ENGINEER (DAY WORKER)
(See D.O.T.--197.130)

CHIEF STEWARD (See D.O.T.--350.138)

COOK-BAKER (See D.O.T.--315.381)

DECK ENGINE MECHANIC (See D.O.T.--625)

DECK UTILITYMAN (See D.O.T.--911.884)

DECKHAND (See D.O.T.--552.887)

ELECTRICIAN (See D.O.T.--825.281)

FIREMAN/WATERTENDER (See D.O.T.--951.885)

FIRST ASSISTANT ENGINEER (DAY WORKER)
(See D.O.T.--197.130)

FIRST OR CHIEF OFFICER (See D.O.T.--197.133)

MESSMAN (See D.O.T.--350.878)

OILER (See D.O.T.--911.884)

ORDINARY SEAMAN (See D.O.T.--911.887)

PUMPMAN (See D.O.T.--549)

REFRIGERATION ("REEFER") ENGINEER
(See D.O.T.--950.782)

SECOND ASSISTANT ENGINEER (WATCHSTANDER,
USUALLY 4 to 8) (See D.O.T.--197.130)

SECOND OFFICER (See D.O.T.--197.133)

SHIP'S CARPENTER (See D.O.T.--860.281)

SURVEY BOAT OPERATOR (See D.O.T.--018.)

THIRD ASSISTANT ENGINEER
(See D.O.T.--197.130)

THIRD OFFICER (See D.O.T.--197.133)

UTILITYMAN (See D.O.T.--318.887)

WIPER (See D.O.T.--669.887)

LONGSHORE

BACKHOE OPERATOR (See D.O.T.--850.883)

CONTAINER-CRANE OPERATOR
(See D.O.T.--921.)

CRANE ASSISTANT (See D.O.T.--892.883)

DERRICK BARGE OPERATOR (See D.O.T.--921.

DRYDOCK HAND (See D.O.T.--891.884)

GANG FOREMAN (HEADER) (See D.O.T.--911.1

GANTRY CRANE OPERATOR (See D.O.T.--921.8

GRAIN TRIMMER (See D.O.T.--781.)

LIGHTMAN (See D.O.T.--)

LOCOMOTIVE ENGINEER (See D.O.T.--910.383

LONGSHOREMAN (See D.O.T.--922.887)

PILE DRIVER (See D.O.T.--859.782)

RAILROAD-HOIST OPERATOR (See D.O.T.--921

ROUGHNECK (See D.O.T.--930.884)

ROUSTABOUT (See D.O.T.--869.884)

SECURING MAN (See D.O.T.--)

SHOP CRANE OPERATOR (See D.O.T.--921.883

SPOUT TENDER (See D.O.T.--929.887)

SPOUT-TENDER FOREMAN (See D.O.T.--929.88

SWITCHMAN (See D.O.T.--910.884)

TRACK LABORER (See D.O.T.--)

WELL PULLER (See D.O.T.--930.883)

FISHERMEN

ALLIGATOR FARMER (See D.O.T.--436.181)

CAPTAIN (See D.O.T.--197.133

CLAM DREDGE OPERATOR (See D.O.T.--431.782)

CLAM DREDGEMAN (See D.O.T.--439.687)

CRAB BUTCHER (See D.O.T.--525.884)

CRAB FISHERMAN (See D.O.T.--431.884)

CULLER (See D.O.T.--)

FISH CLEANER (See D.O.T.--525.884)

FISH CULTURIST (See D.O.T.--041.168)

FISH-CULTURIST ASSISTANT (See D.O.T.--)

FISH FARMER (See D.O.T.--436.181)

FISH ICER (See D.O.T.--222.587)

FISHERMAN, DIVING (See D.O.T.--439.884)

FISHERMAN, LINE (See D.O.T.--432.884)

FISHERMAN, POT, TRAP (See D.O.T.--431.884)

FISHERMAN, SPEAR (See D.O.T.--433.884)

FLOOR LADY (See D.O.T.--)

FROG FARMER (See D.O.T.--436.181)

HEADER (See D.O.T.--)

KELP CUTTERMAN (See D.O.T.--437.887)

LINE FOREMAN OR LINE SUPERVISOR (See D.O.T.--)

OYSTER FLOATER (See D.O.T.--439.887)

OYSTER SHUCKER (See D.O.T.--521.887)

OYSTERMAN OR DREDGER (See D.O.T.--436.884)

PRODUCTION SUPERVISOR (See D.O.T.--

QUALITY ASSURANCE DIRECTOR (See D.O.T.--)

RIGMAN (RIGGER) (See D.O.T.--)

SEAL HUNTER (See D.O.T.--439.884)

SHELLFISH GROWER (See D.O.T.--436.181)

SHELLFISH-PROCESSING-MACHINE TENDER (See D.O.T.--529.885)

SHELLFISH SHUCKER (See D.O.T.--521.887)

SHRIMP-PEELING-MACHINE TENDER (See D.O.T.--529.885)

SPONGE CLIPPER (See D.O.T.--437.887)

SPONGE GATHERER (See D.O.T.--437.884)

TASTER (See D.O.T.--381.887)

TONGER (See D.O.T.--436.884)

WALRUS HUNTER (See D.O.T.--451.884)

LABORERS

BREADER (See D.O.T.--)

CLEANER (See D.O.T.--891.887)

FISH-MACHINE FEEDER (See D.O.T.--521.886)

HATCHERY MAN (See D.O.T.--436.884)

HULL SCRAPER-SCALER (See D.O.T.--

MARINA ATTENDANT (See D.O.T.--)

PEELER (See D.O.T.--)

SHELLFISH PROCESSING LABORER (See D.O.T.--529.886)

SHELLFISH-BED MAN (See D.O.T.--436.884)

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THE MARINE TECHNICIAN

Beginning in the early Sixties the marine technician as an occupational group has received considerable attention in the literature, perhaps more attention than any single marine manpower topic. Many local, regional, and national meetings have focused on this single question: "What are the needs for marine technician training programs?" As a result of many of these meetings and conferences separate documents have been published with the first in the mid-sixties and the most recent in late 1974. Not one of the studies indicates that the analysis of current and future labor market requirements was conducted within the framework of the national market structure. Most marine technician studies employed a small sample survey technique and extrapolated conclusions based on whatever results were obtained from responding employers. There is nothing wrong with the survey research method so long as an adequate sample of the universe is taken, and sufficient results are obtained from informants capable of making valid and accurate statements. Determining the universe of employers is a first step when using a sample survey approach. Deciding sample size and minimum response levels are logical second steps, once the universe of marine employers is known. A recent national level study of marine technician need selected as its source of marine employing industries in the U.S a single trade association directory. This document was in fact a partial listing of manufacturing firms which sell marine equipment or provide R and D support services to marine based industries. To be listed in the document, the publisher required firms to pay a fee, similar to paid advertisin

This single source was assumed to represent sources of marine technician employment. In fact the response indicated that many of the firms did indeed employ marine technicians and indicated an interest in hiring additional marine technicians. Since the directory was the basic source for determining the universe of employers and the list of firms mostly represented manufacturers, the data used for analysis and forecasting must be left open to serious question.

The Federal agency most responsible for reporting national employment information is the U.S. Labor Department's Bureau of Labor Statistics. In 1975 BLS had no single or comprehensive definition of marine employers. Fisherman and all off-shore harvesting of sea food is reported as part of the agricultural labor force. Seafood processing on the other hand is part of non-durable manufacturing. Merchant marines, tug boat operators and Mississippi River cargo carriers are all part of transportation. In fact there is no single major heading for reporting marine based employment. To make this determination, one must begin with the general reporting catagories and then systematically examine under each major and sub heading, potential sources of marine employment. To initiate this procedure, a tentative definition is necessary. The process identifies potential marine industries that may or may not fall within the definition, the definition can be relaxed or made more precise to select out "non pure" marine industries. The most common procedure followed in locating place of employment is described in the Manual of

Standard Industrial Classifications. A search of the SIC system provides a listing of 200 separate industries that do business "on or under the water or on shorelines in support of water based employment activity." The SIC system identifies only the title of each industry. But industry titles provide a basis for establishing the universe of what is to be included as marine based industries.

A similar procedure can be followed in pin pointing occupations, including marine technicians. The Department of Labor groups technicians with professional occupations at the most general level. However it is then possible to examine specific technician level occupations from that general classification. To begin to pin point marine technician employment, it is necessary to follow a process of approximation and iteration. This process begins with the longest or general occupational group.

For purposes of this discussion it is useful to breakdown all of the reported technical occupations as of 1970, the most recent data available.

100%	Total Technicians		1,219,422
21%	Health Technicians		260,102
13%	Technicians other than Health & S & E (includes pilots, controllers, flight engineers, radio operators, embalmers)		155,598
	Engineering and Science Technicians		803,722
23%	Draftsmen	285,256	
5%	Surveyors	59,482	
	Agricultural & Biological (excluding health)	31,785	
	Chemical	60,403	
38%	Electrical & Electronic Eng.	154,262	
	Industrial Engineering	20,342	
	Mechanical	770	
	Eng. & Sci. Techn. N.E.C.	178,169	

Some of the above classified technicians are easily associated with an industry group and others are claimed by industries and educators who clamor for instructional programs and the services of very specially trained personnel to assist the professional and to accommodate advancing and changing technology.

98% of all Health Technicians are employed in the Service industries (Medical and other Health Services primarily)

(21% of all "technicians")

Draftsmen are in Construction (10%), Manufacturing (49%), Transportation, Trade, Government and Advertising (12%) and Engineering and Architectural Services (27%).

(23% of all "technicians")

Surveyors are in Construction (30%), Manufacturing, Transportation, Mining, and Government (23%), and Engineering and Architectural Services (45%).

(5% of all "technicians")

All Air Traffic Controllers are in Government while Radio Operators are divided almost equally between Government and Transportation, Communications and Public Utilities. Pilots and Flight Engineers are primarily in Transportation; Embalmers are employed in the Services Industries; and tool programmers are in Manufacturing.

(13% of all "technicians")

Consequently the remaining 38% of all technicians are engineering and science technicians who give support to professionals in all industries, developing and advancing in technological change. The Bureau of Labor Statistics places almost half of these technicians in the manufacturing industries and the balance distributed among Construction (8%), Transportation (8%), Trade (5%), Education (8%), Government (3%) and other Services (9%).

These technicians number about 458,000 workers and represent almost six tenths of one percent of the total U.S. labor force as of 1970.

Professional/Technical employment in 1975 increased from 11 million in 1970 to 13.3 million workers. The ratio of technicians to professionals increased slightly over this 5 year period and it is estimated that the technician level of employment increased from 1.2 million in 1970 to approximately 1.6 million in 1975.

We have examined how the U.S. Labor Department reports technician occupations. Since marine technicians are not reported as a single specialty we must construct a system that will provide a means to approximate the number of marine technicians currently employed and through iterations improve each estimate until a reasonably accurate figure is derived to provide a basis for planning new directions.

A reasonable first approximation suggests 40,000 are employed as marine technicians if draftsmen are included. It is appropriate to include this occupational specialty in as much as their place of employment and training requires "knowledge and skill unique to the marine environment."

Employment opportunity as a marine technician should continue to be favorable in the late 70's and early 80's. Career advancement for technicians into higher level occupations will depend upon their receiving additional education and on the job training. New technical level job opportunities should expand

in the recreation and service industries, particularly in business administration, scientific instruments, marine electronics and environmental/regulatory type occupational specialties.

the individual be at least fifteen years old and can demonstrate good physical condition and watermanship by being able to: (a) swim 200 yards continuously without fins in less than six minutes, and (b) stay afloat or tread water for ten minutes without accessories. Certificatic agencies include the National Association of Skin Diving Schools, The YMCA, National Association of Underwater Instructors, and the U.S. Navy All instuction programs have a rated instructor and conform to American National Standards. Certification is often required to obtain air, equipment, and services.

There are only a few diving programs at the high school and communit college levels. Two examples are: Santa Barbara City College in California and Highline Community College on Puget Sound near Seattle, Washington. The Santa Barbara course, Marine Diving Technology, offers instuction leading to an Associate of Arts degree and is built subjects including small boat handling, navigation and rigging, basic diving (scuba and hookah), physical oceanography, biological oceanograp and marine biology in the technical area; technical physics, technical algebra and trigonometry in the science-mathematics area; and marine law and economics, technical report writing and business speech in the general education area. To complete requirements for the marine diving technician program a student takes advanced diving, underwater construction, underwater operations, drawing and blueprint reading, fundamentals of marine engines and compressors, combination welding, machine shop operations, fundamentals of electronics, and application of electronics.[1]

Peter Williams, master diver and one of two diving instructors at Highline Community College declares the aim of their program is "not just to give the student a degree, but to place people in a job, and

[1] write to: Ramsey Parks, Santa Barbara C.C. Santa Barbara, CA 93109

A CAREER IN DIVING

From the beginning of recorded history man has been fascinated by the power and majesty of the sea and sought to explore and exploit it. During the time of Homer's Illiad reference was made to diving--Alexander the Great used the forerunners of the W.W. II "Frogman" to destroy underwater obstructions. In the 1800's the cumbersome "hard hat" diver began to open the sea floor to exploration. In 1943 Jacques Yves Cousteau paved the way for the great freedom and mobility undersea man now enjoys with his introduction of the SCUBA (self contained underwater breathing apparatus). Today the world of innerspace, the world of weightlessness, silence, and ethereal beauty is more accessible than ever and new technology and courage bring man farther and farther into its realm.

For the young person whose imagination has been captured by the beauty and call of the sea a career in diving offers an exciting and challenging opportunity. To be realistic, however, diving must be recognized as merely a means of transportation to the job - some skill or knowledge is needed in addition to the basic skill of diving; of the four types of divers (scientists, underwater photographers, sport, and commercial divers) the overwhelming number are sport divers, many of whom would be delighted to make a career of diving but lack the skills that science and industry require.

Divers trained as technicians in oceanography or the marine sciences (biology, chemistry, physical, and geophysical oceanography) will find some jobs working with scientists as support people in research and development. Marine scientists acquire their academic

credentials and then learn diving as needed - to be an Oceanographer today virtually demands a PhD and one then is a scientist first and a diver second. Diving is a tool supplemental to one's mainstream activity and this distinction should be noted. Jobs in marine science are very desirable and rather scarce and depend largely on our government's commitment to the exploration of inner space. Scientists are, of course, needed in the private sector - particularly in the emerging offshore oil, mining, and aquaculture industries. Divers with skills in underwater construction and repair, cement working, mechanics, electronics, and cutting and welding are also sought by industry. Salvage divers and underwater photographers provide some employment opportunity but variability in individual skill and industry needs makes it difficult to determine how great the need is. Ultimately the young person whose interest in diving is career oriented should talk or write to as many local divers and marine industries as possible and aim at getting a clear idea of job openings, skill requirements, and expected tasks. Because of the booming popularity of sport diving, an emerging career field for consideration is that of diving instructor. The enclosed directory provides ample listings, and I again emphasize the importance of contacting working divers - make their experience a facet of your learning experience.

Diving is a demanding physical activity and requires good overall health, endurance, and emotional stability. Of specific and utmost importance is that the future diver be free from cardiovascular and respiratory disease and that the middle ear functions well in equalizing pressure. A thorough physical examination is strongly recommended. Certification as a Basic Scuba Diver also requires that

insure they have the basics to perform that job." As of last year, about 50 of the 72 graduates of the Basic Diving Technician Program ha been placed in diving jobs. The Highline program, called Underseas Technology includes in its core curriculum instruction in diving, seamanship, welding, engineering, and physical education (including life saving and first aid), communications, and mathematics. Included in the diving portion of the curriculum are: Scuba diving, conventional helmet or "hard hat" diving, light (swimmer) helmet diving, hookah diving, decompression, underwater photography, underwater engineering applications, underwater construction applications, and salvage techniques. Highline's modern equipment, including diving bell and decompression chamber add to the appeal of the program.[2]

Certainly the most extensive and far reaching program for the would-be diver is that of U.S. Navy. The Navy continues its leadership in the development of the science and technology of diving and in the excellence of its standards. However, because of the quality and high degree of competition for acceptance in its diving programs the Navy cannot guarantee placement. Fifteen to twenty percent of the applicant are accepted and make up a Navy Diving Force of 2,500.

Wages and working conditions for the career diver vary greatly. A very small percentage of divers make their living in tropical seas. The great bulk of working divers find cold water, low visibility, and hard work to be their normal working situation. Wages too, are hard to pin down, because commercial divers usually work on a scale based on depth of dive, hazards, nature of operation, etc. Divers

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[2]Write to Highline Community College, Midway, Washington 98031.

earn from $50 per day for non-union divers employed in the New England area to $125 in Southern California and the Gulf.

Recreational diving has enjoyed a tremendous increase in popularity in the last decade, expanding from one million participants spending $300 million in 1964 to more than an estimated three million participants spending $900 million in 1975.[3] The trend is part of an overall increase in the appeal of the marine environment for recreation and is reinforced by man's fascination with the world of inner space which inspires such words as "beauty, silence, tranquility, peace, and freedom." This world becomes increasingly accessible as technological advances in the science of diving make sport diving ever easier to learn and safer to participate in.

Popular activities include spearfishing, underwater photography, collecting shells, and just plain exploring. Skindiver, the magazine in the field, emphasizes the travel, adventure, beauty and lure of the deep and could provide young persons with a feel (albeit glamorous) for the undersea world.

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[3]Stratton Commission Report, p.53.

ALTERNATIVE LEARNING ACTIVITIES

Central to all curriculum efforts is the learning activity. Individuals have different interests as well as different learning styles. To accommodate individual differences and abilities two alternative learning strategies are proposed for the acquisition of marine skill and knowledge requirements. The strategy includes suggestions for optimizing student acquisition to data and efficient learning or training experience. Pre and post testing procedures are suggested as well as techniques for individual student evaluation.

The marine occupational training programs visited by the study team, for the most part, focused on a narrowly defined occupational area. The approach followed the USOE Vocational Instructional Program model described in the introduction of this document. This is a highly successful strategy and should continue to be followed when developing new curriculum. But the manpower requirements of the industry clearly indicate that many of the job vacancies and potential job openings will require specialized preparation in one facet of marine employment and comprehensive training in a non-marine occupation.

A boatyard operator now requires comprehensive training in many facets of marine work as well as the specialized skills

of bookeeping, quality control and inventory management. An accountant on the other hand, if he is to bring his special skills to help the boatyard manager, must acquire a definable set of marine-based skills. A general mechanic originally trained in the automotive field can find employment in a marina, a boatyard and related settings if that person can demonstrate the specialized knowledge of marine engines, machinery and marine safety.

The commonalities search proposed as part of the marine occupational analysis will permit curriculum designers to prepare special "marinization units" that can be mastered by individuals who already have a skill base or by students enrolled in marine-related occupational training. The marinization units should greatly facilitate the design of individual learning packages as well as enhance the more traditional program offerings.

The second learning strategy that should be fostered by marine education curriculum designers follows a more traditional approach. The traditional approach suggested here makes the assumption that the teaching staff possesses a mastery of subject matter and industry employment experience. The approach also assumes the learning activity is school and shop based. The recommended learning focuses on the preparation stage of career development. What follows is a comprehensive course outline at a general level. More specific occupational requirements and inputs from industry advisory persons can add details

to this outline. This outline, while specific to a single career setting (boatbuilding), provides the structure that will be required to design curriculum for most of the marine employment and occupational areas at the preparation stage of career development.

PROPOSED BOAT BUILDING COURSE

SAFETY

The practice of safe working conditions should run throughout the instructional program. The student should quickly learn to appreciate that he has entered the adult world, and that the woodworking equipment is expensive. The prevention of accidents should be stressed throughout. So should the need for the tidy layout of materials and equipment to avoid accidents. Stress should be also placed upon the employee's responsibilities to self and to fellow workers as well as on the legal obligations of employer to employees.

It is not expected, however, that formal instruction in safety should occupy an undue proportion of the course; instead, safety considerations should be introduced as they arise naturally in the course work. In tests, questions should be asked on the topics of safety in relation to the specific parts of the course. Knowledge of the appropriate OSHA Regulations should be included but not the ability to quote from publications, official or otherwise.

CRAFT RELATED STUDIES PART I

CLASSROOM ACTIVITIES	EXAMPLES OF SHOP ACTIVITIES
Measurement and Marking Out	
1. Basis of measurement. Standard of length as a basis for all measurement. Principles of marking out. Use of datum and center lines. The establishment of vertical and horizontal plane by the 'bubble' level and plumb line, declivity stick.	Examples to include three-dimensioned objects related to yacht and boat building.
2. Accuracy. Accuracy obtained from use of rules, callipers, dividers, trammels and gauges.	Student participation on the measurement of actual objects by various methods and comparison of results.
3. Measurement of angles. Setting out and measurement of angles, the protractor	Checking, lifting, and transfer of bevels.
4. Marking and setting-out. Introduction to drawing-in and setting-out rods. Marking off for single and repetitive work.	Practical examples, comparison of methods.
5. Introduction to lofting, use of molds and templates.	Comparison of moulds and templates with reference to ship joinery and yacht and boat building.
Materials	
6. General characteristics of common hardwoods and softwoods including origin, structure and use.	Choice of timbers for specific purposes.
7. Timber conversion, effect of shrinkage, importance of airflow in the preservation of timber. Air seasoning, kiln drying and conditioning. Calculation of moisture content. Elementary consideration of the cause and effect of wet and dry rot; insect attack. Common defects. Heat treatment for bending and shaping.	Participation in laboratory experiments and demonstrations, such as comparison of wet and dry timbers, assimilation of show movement.

CLASSROOM ACTIVITIES	EXAMPLES OF SHOP ACTIVITIES
Materials	
8. General characteristics of composite boards.	Comparison of the advantages and disadvantages of plywoods and composite boards with timber.
9. General characteristics of ferrous and non-ferrous metals.	Examples of the working properties (cutting and drilling, shaping and bending).
10. General characteristics of plastics.	Examples using decorative plastics laminates.
11. Introduction to glass-reinforced plastics, GRP.	Examples using glass-reinforced plastic hand lay-up.
Craft Science	
12. Absorption of water by materials, porosity, capillarity throatings and anti-capillary grooves.	Laboratory demonstrations, examples of joinery counter-measures and precautions.
13. Application of vapour and water barriers.	
14. Acids and alkalis, chemical inter-reaction between timber and metals.	Practical demonstrations, examples of countermeasures and precautions.
15. Electrolytic action between dissimilar metals.	Practical demonstrations, examples of countermeasures and precautions.
16. Density, volume and specific gravity of liquids and solids.	Simple demonstration of relative densities.
17. Principles of moments and levers, simple beams.	Working examples of forces, resultant and equilibriant of parallel force systems. Simple problems solved by graphical means.
18. Elementary description of work and power	Experiments with simple machines.

CLASSROOM ACTIVITIES	EXAMPLES OF SHOP ACTIVITIES
Tools and Equipment	
19. Survey of common handtools including ploughs, rebate planes, curve cutting tools.	Selection, care and maintenance.
20. Portable power tools: sanders, drills, jigsaws, screwdrivers, staplers and ballistic guns, safety factor.	Demonstration, application and use of electrical and compressed-air power tools.
21. Woodworking machinery: sawbench, surface planer, thicknesser, morticing machine, bandsaw.	Demonstration and elementary use. Sequence of operation in preparing timber for use. OSHA relevant parts, safety precautions. Use of patterns and jigs for holding, guidance and assembly.
Jointing of Timber	
22. Different types of joints for widening, lengthening and framing timber, including comb or finger, dowelling, housing, halving, cross bridle, dovetail, halving, mortice and tenon, dovetail: laminated work; cold moulded construction.	The solving of situation problems and selection of appropriate joints (a) Box construction (common and drawer dovetails). (b) Bound work (mortice and tenon including rebated gunstock stiles and carcasing for furniture). (c) Shaped, curved and laminated work. (d) Lengthening joints (lip and feather edge scarphs). (e) Cold moulded construction.
Fixing and Jointing Devices	
23. Screws, nails, bolts, rivets, shrinkage plates, joist hangers, framing anchors, stapling and corrugated fasteners, wood fibre and other plugs.	Practical tests to compare the holding power of nails, screws and adjesives in various types of condition.

Drawing and Sketching

THE OBJECTIVE OF THIS SECTION IS TO PROVIDE THE STUDENT WITH A GENERAL KNOWLEDGE OF DRAWING WITH ORTHOGRAPHIC AND ISOMETRIC PROJECTION, TO A STANDARD WHICH ENABLES HIM TO READ A DRAWING AND TO COMMUNICATE BY MEANS OF FREEHAND SKETCHING.

CLASSROOM ACTIVITIES	EXAMPLES OF SHOP ACTIVITIES
Drawing and Sketching	
24. Preparation, lettering, scales and construction lines.	Suggested drawing exercises (a) Small stool or table with plastic top including exploded isometric detail of joints. (b) Small cabinet with plastic top, drawer and flush door. (c) Exploded isometric details of carcase, drawer and door joints. (d) Panelled door with exploded isometric joint detail. (e) Small single panelled or flush horizontal sliding service hatch. (f) Vertical sliding hatch with counter-balancing system. (g) Storage racks, gallows brackets and modern methods of shelf support. (h) Notice board with hinged glazed door. (i) Simple formers suitable for construction and curved template work. (j) Small folding tables. (k) Simple straight stair without newel post. (l) Body moulds from offsets. (m) Section of stem from mould loft floor. (n) Typical boat sections. (o) Section of rubber (pear shaped). (p) Boom crutch. (q) Spoon oar. (r) Cleats. (s) Semi-circular floor grating. Portion of deck with mast hole and wedges.
25. Symbols for materials in common use.	
26. General principles of orthographic, isometric and oblique projections and freehand sketching.	
27. Construction of plane figures.	
28. Sections and surface developments of regular solids.	
29. Planes of projections.	
30. Circle, ellipse, tangents and normals and their applications.	
31. Setting out arches and compound curves and use of ordinates.	

Workshop Calculations

THE OBJECTIVE OF THIS SECTION OF THE INSTRUCTIONAL PROGRAM IS TO PROVIDE THE STUDENT WITH ONE OF THE BASIC TOOLS OF THE CRAFTSMAN. THE EMPHASIS SHOULD BE ON CALCULATIONS AS AN AID TO THE PLANNING OF OPERATIONS AND THE EXERCISE OF PRACTICAL SKILL, AND SO OFTEN AS POSSIBLE, CALCULATIONS SHOULD BE TAUGHT IN DIRECT RELATION TO OTHER SECTIONS OF THE COURSE.

CLASSROOM ACTIVITIES	EXAMPLES OF SHOP ACTIVITIES
Workshop Calculations	
32. Averages, ratio and proportion.	Examples to be used of a practical nature and applicable to either ship joinery or yacht and boat building.
33. Metric units of measure, their use and application.	
34. Simple indices, introduction to logarithms.	

CRAFT SPECIFIC PART II

LOFTING

Craft Principles and Applications	Workshop/Laboratory Activity	Associated Studies
1. Tools and material used with mould loft.	Preparation of battens and loft boards.	Construction of plane figures, section and segments of circle.
2. Function and relationship of tables of offsets, profile half breadth of body plans.		Representation of geometrical solids and joints in orthographic projection.
3. Lifting of levels and construction of templates.	Laying off full size, and construction of templates and moulds.	

CONSTRUCTION (WOOD)

This section covers the general principles of wood.

1. Comparison of, and reasons for, different types of wood construction in boat building.	Projects should include the following: setting up jigs; levelling off fore and aft and athwartships. Construction backbone and inserting in jig. Spiling for planking and methods of fastening.	Structure and identification of timber: defects.
2. Construction and basic principles of setting up jigs, stocks, backbone framing, chines, gunwales and stringers. Fitting of stern, keel or transom, and spiling for planking.		Air seasoning and kiln seasoning. Laminating and bending timber.

CONSTRUCTION (WOOD)

Craft Principles and Applications	Workshop/Laboratory Activity	Associated Studies
3. Construction and fitting of internal members including thwarts, centre case, rudder, mast step and hull fitting.		

CONSTRUCTION (GLASS REINFORCED PLASTIC)

1. Safety, Health and fire hazards associated with work in G.R.P. Necessity for stringent safety precautions. 2. Construction of, and methods of producing, plugs and moulds. 3. Resin and catalyst systems. 4. Formulation of various combinations of glass reinforcement. Bonding of furniture to G.R.P. 5. Preparation of mould including waxing and application of release agent. 6. Tools used in working G.R.P. 7. Plug construction including: incorporation of inserts for deck fittings, non-skid surfaces, skin fittings, hull stiffenings and datum points for fixing internal fittings.	Projects should include the following (a) Mould construction from information lifted from the loft floor. (b) Investigations of various forms of building construction including testing of specimens to NAERM Standards. (c) Comparative tests on the effect of orientation and glass quantity for small boat construction. (d) Applications of the various types of glass reinforcement used in G.R.P. boat building. (e) The effects of working G.R.P. materials with tools, including powered hand tools.	Isometric and oblique projections as a basis for producing sketches for workshop use. Investigation of the physical properties of G.R.P. Workshop conditions heating, air conditioning, humidity control, dust and fume extraction. Workshop conditions and workshop hygiene as a prerequisite for safety.

Craft Principles and Applications	Workshop/Laboratory Activity	Associated Studies
8. Design features of moulds for complete internal units, such as toilet compartments, galley units and accommodations.		
9. Process specification for hair lay-up and spray techniques.		
10. NAEBM rules and recommendations for the construction of G.R.P. hulls.		
BOAT JOINERY		
1. General arrangement of accommodation and constructional details of furniture.	Tests for strength and weathering of plywood and wood substitutes. Practical appreciation of the various joints.	Intersection of straight and circular mouldings, raking moulds and hopper levels.
2. Installation of bulkheads and laying cabin sole.	Setting out rods. Assembly and finish of production shop work.	The timber standard and cubing for hardwood.
3. Design and construction of joinery with emphasis on modern design and methods of construction.	Setting out and preparation of timber for machinery.	
4. Cabin layout; design and construction of bunks, settees with drawers, wardrobes, toilet compartments and gallery layouts.		Calculation of simple labour and material requirements in terms of quantities and waste.

Craft Principles and Applications	Workshop/Laboratory Activity	Associated Studies
WOODWORKING MACHINERY		
1. Safety precautions relating to woodworking machinery. Specific requirements of OSHA.		
2. Circular saw: types of teeth for rip-sawing and cross cutting, crown guard, riving knife, push stick and packing.	Demonstration and use of woodworking machinery for various applications. Dismantling for sharpening and use of sharpening machines.	Machine shop and plant layout to show provision for gangways and safe movement of material.
3. Planer: thicknessing and surfacer, cutter blocks, cleaning and fitting table rollers, correct feedspeeds; cutter grinding and balancing.		
4. Standard narrow bandsaw; sharpening and setting, jointing, correct saw mounting, guides and guard adjustment.		
SAIL PLANS		
1. Types of rig, masts, booms, and spinnaker poles.	Methods of lifting and handling to avoid strain and injury.	Consideration of forces and slings vector diagrams; triangle and polygon of forces.
2. Fitting and fixing associated deck fittings.		
MACHINERY INSTALLATION		
1. Construction and installation of engine beds for wood and G.R.P. hulls, installation of "A" brackets, out drives, stern tubes and lining up of engine.	Lining up and using dial gauges, feeler gauges and jigs for engines.	Glavanic corrosion due to materials used especially ferrous and non-ferrous metals. Elementary concep of friction. Elementary machines. Velocity ratio; mechanical advantage efficiency, screwjacks an their application.

Craft Principles and Application	Workshop/Laboratory Activity	Associated Studies

2. Construction and fitting of battery boxes, fuel tanks and fresh water tanks. Engine fuel lines and exhaust pipe systems.

3. Steering: manual and power-assisted systems. Construction and installation of rudders in wood and G.R.P.

DECK FITTINGS

1. Fitting and fixing hardrails, pulpits, stanchions, winches, sheet leads, chain plates, anchor and dinghy storage.

2. Hatches, vent boxes and cleats.

Demonstration of the erection and use of staging, including tubular scaffolding and ship to shore gangways with particular emphasis on safety precautions.

Safety, tools, materials, techniques and process are central to all courses of occupational education. This same cutline should be developed for all of the employment settings at this general level and made more specific as improved manpower information is made available.

1. The tasks occurring in each activity should not be treated simply as exercises to be carried out, but as opportunities to examine the relationship between theory and practice;

2. Opportunities for teamwork should be provided, and each student should have his own responsibilities, while being encouraged to plan and work in conjunction with other members of the class;

3. The teacher might act as a consultant, available as a source of information and assistance when required, encouraging students to seek other sources of information and to have ready their own answers and approaches before referring to the teacher.

The recommendations outlined above are illustrative and there is, of course, no intention to inhibit the development of other approaches. For example, a group project which included members from other occupational areas would be counted toward fulfilling the requirements of this course and of the other courses (if appropriate); and a project giving more emphasis to the planning of work than to the production of hardware could be equally acceptable.

This Boat Building Course gives examples of the sort of practical activity which may be found suitable as an integral part of the instructional program. It is hoped that teachers will develop their own ideas of experimental and investigational activity to supplement or replace examples. It is assumed, however, that the effective teaching of the course will require as much practical work of this nature as can be included in the time available, and that many of the topics will be best taught in the workshop or learned through a well designed Co-op arrangement.

PROFESSIONAL DEVELOPMENT NEEDS

A properly structured teacher training program, designed to provide students a sound basis for adequate career choice among the fourteen marine occupational families, must logically be built around five major components:

* Basic content for each of the 14 marine occupational families.
* Student learning activities by level and type.
* Adequate and coordinated materials tied to each grade level.

* Work observation and related experiences.

* An articulated pre and post testing program.

These components complement each other, all elements being necessary to provide comprehensive career planning.

The training of teachers and counselors in the scope of the Marine Career Education Program would insure the proper use of the Curricula and materials. A curriculum guide by phase will integrate the student learning activities with the basic course content and work observations and/or experience. Teachers should be trained to involve the community and its resources as well as to identify new sources of information and learning activities. The counselor must be appraised of occupational information including: job description, working conditions, entry requirements, personal requirements, job identification/ task identification, training requirements. Appropriate and articulated decision-making skills and models should become part of the counselor training.

At present, there exists a mechanism for Personnel Development of instructors and guidance counselors. Ic is the newly organized National Marine Education Association. As a national network, the association includes members from government agencies, industry and all levels of education. The network provides a potential capability to bring to marine career curriculum development all regions of the country, all occupational levels, and all employer settings. Any effort that is less than national in scope simply will not produce the comprehensive and articulated curriculum needed to meet growing

student interest and expanding employment opportunities.

It is proposed that any effort in professional development be conducted so that the instructional and guidance staff of marine education programs directly participate in the design of specific learning environments and trial testing of all instructional materials. Such participation will enhance the design and relevance of both the model program and supporting materials.

Implementation

Curriculum Guides directed to the four phase Model Curriculum should be produced to assist the teachers in implementing the program. Work observation and/or experience guidelines should be developed for implementation during the Orientation phase. A system of pre and post testing could be articulated throughout the curriculum to aid in career planning.

As a first step in implementation of the Marine Career Curriculum, a decision must be made as to how and where it should be included in the school's curriculum. The curriculum may be implemented by separate courses, by infusion into existing programs or by the addition of marine components to existing programs where appropriate, e.g., the "marinization unit approach". The curriculum guides would suggest methods for inclusion in the existing curriculum as well as the development of separate marine courses, e.g., two-part course on boatbuilding at the Preparation stage. In some cases, existing curricula could be "marinized" to fulfill the objectives of that particular phase.

Test Site Evaluation

An important element in the Marine Career Education Program must be the choosing of appropriate pilot test sites and the evaluation of an Advisory and Review Committee. Materials must be developed and field tested. Curriculum Guides must be organized and tested. An articulation plan must be introduced, personnel trained and the model implemented and evaluated. Regionalization in the marine occupations lends itself to appropriate curriculum and materials development as well as site testing.